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Implant-based breast reconstruction is the most commonly used reconstructive modality following mastectomy. Placement of the tissue expander and implant under the pectoralis major muscle is believed to minimize the incidence of capsular contracture, provide adequate soft tissue coverage, and minimize implant visibility and palpability. However, utilization of the submuscular pocket can be associated with discomfort, which may originate from stretching of the cutaneous envelope, distension of the underlying muscle or, rarely, from spasms of the pectoralis major muscle. A case of intractable and involuntary pectoralis major spasms following submuscular implant-based breast reconstruction is presented. An ultrasound-guided pectoral intrafascial plane block is shown to be an effective diagnostic modality, implicating the medial and lateral pectoral nerves in these symptoms.

CASE PRESENTATION
A 59-year-old otherwise healthy woman who was diagnosed with ductal carcinoma in situ of the right breast in 2008, requiring a lumpectomy, is presented. Further investigations revealed contralateral disease (ductal carcinoma in situ), prompting bilateral skin-sparing mastectomies with immediate two-stage expander-implant breast reconstruction. Of note, the patient did not receive chemotherapy or radiotherapy, and axillary dissection was not performed.

In the postoperative period following placement of the expanders, bilateral puckering and superior retraction of the pectoralis major muscles were noted. Additionally, animation deformity and involuntary spasms of the pectoralis major muscles were observed on both sides. The spasms occurred up to several times per minute and, on occasion, were associated with burning pain over the medial border of the breast. In an attempt to address the pectoralis muscle deformity and spasms, the anterior aspect of the pectoralis major muscle was released from the subcutaneous tissues during the second stage expander-to-implant exchange procedure. Unfortunately, the symptoms did not resolve and the spasms worsened over time.

In 2011, she presented to the authors’ institution for a second opinion. Examination revealed significant animation deformity of her breasts bilaterally. Skin retraction and dimpling were present on both sides and were accentuated by movement of the pectoralis major muscles. The muscles were found to be superiorly retracted on both sides (Figures 1A to 1C). Involuntary spasms of the pectoralis major muscle were observed bilaterally, occurring several seconds apart (Video 1). The spasms were more pronounced on the right. There was no pain on palpation over the affected muscles and motor, sensory and neurological examination of the upper extremities was unremarkable. There were no other neuropathic symptoms such as paresthesia, sensation of electrical shocks or symptoms suggestive of alodynia, hyperalgesia or dysesthesia.

All treatment options were thoroughly discussed with the patient. The decision was made to proceed with bilateral replacement of implants, partial capsulectomy and reconstruction of the subpectoral pocket using AlloDerm (LifeCell, USA) as a pectoral extender down to the inframammary fold. This was performed in an attempt to address pectoralis major animation and deformity and potentially correct the muscular spasms. The procedure was performed in May 2012. The old textured anatomic 495 g implants were removed and replaced with smooth, round 505 g gel devices.

Despite mild postoperative improvement, the intractable and involuntary muscular spasms persisted and their etiology remained unclear. The remaining surgical options were discussed with the patient, consisting of explantation of implants or neurectomy of the medial and lateral pectoral nerves. The patient wished to keep her implants and opted for the denervation procedure.

Before proceeding with surgery, the present case was discussed with the anesthesia department of the authors’ institution to determine the proper surgical approach. A novel diagnostic approach using ultrasound-guided pectoral intrafascial plane block is discussed.

Key Words: Breast; Muscle spasm; Neurectomy; PECS1 block; Reconstruction
whether a nerve block could provide useful information toward a potential diagnosis. The objective was to determine whether anesthesia of these nerves would result in resolution of symptoms, thereby helping establish the potential benefit of the planned procedure. Following consultation, a pectoral interfascial plane (PECS1) block was proposed. This procedure is commonly performed in the authors’ hospital for postoperative analgesia in breast surgery cases and consists of ultrasound-guided injection of local anesthetic into the plane between pectoralis minor and major in the vicinity of the medial and lateral pectoral nerves. In June 2014, 10 mL of 0.5% ropivacaine together with 10 mL of 2% lidocaine and 1:200 000 epinephrine was injected into the pectoral interfascial plane of the right breast, resulting in immediate and complete relief of symptoms (Video 2). This outcome, although short-lived, lasting only the duration of the local anesthetic, provided evidence that denervation would at least partially alleviate the patient’s symptoms.

The patient underwent successful denervation of her pectoralis major muscles in November 2014 and both medial and lateral pectoral nerves were transected. In addition, the right pectoralis major muscle was disinserted from the humerus. In the immediate postoperative period, the patient noted significant improvement of her involuntary muscle spasms bilaterally. At her six-month follow-up, the spasms were nearly completely gone, with only mild sporadic spasms appearing on the right (Figures 2A and 2B, Video 3). The patient was very satisfied with the final result.

**DISCUSSION**

We present a rare case of nonremitting involuntary spasms of the pectoralis major muscles following submuscular two-stage implant-based breast reconstruction diagnosed using a PECS1 block. This complication, although exceedingly rare, may be debilitating and distressing to patients affected. Several comparable cases have been reported in the breast literature.

Mast (3) described a patient with severe pectoralis major spasms following sternal wound reconstruction with bilateral pectoralis major flaps. The patient failed conservative management with muscle relaxants. Neurological blockade was planned; however, it was not attempted due to distorted anatomy. Ultimately, neurectomy of both medial and lateral pectoral nerves was performed with complete resolution of symptoms.

Wong (4) presented a 31-year-old woman who underwent bilateral prophylactic mastectomy with immediate single-stage submuscular implant-based reconstruction. Following initial infection and explantation, the left implant was replaced and the patient remained asymptomatic for several years. Five years postoperatively, she developed left chest muscle spasms associated with burning pain, which occasionally radiated down her left arm. The symptoms were aggravated by use of her arm and reportedly also occurred during sleep, although at a diminished level. Physical examination revealed diffuse, spontaneous myoclonic jerks of her left pectoralis muscle associated with diffuse muscle tenderness. Intramuscular injection of botulinum toxin on two instances resulted in temporary relief of symptoms. The patient underwent neurectomy of the lateral pectoral nerve alone, which provided minimal improvement. Subsequent open capsulectomy, detachment of pectoralis major from its origin on the humerus and transection medially form sternum did not relieve symptoms. Finally, explanation resulted in resolution of symptoms.

More recently, Adkinson et al (5) reported a 36-year-old woman with left breast cancer who initially underwent unilateral mastectomy and contralateral prophylactic skin-sparing mastectomy with immediate placement of expanders in the subpectoral plane. Postoperative
wound breakdown and expander exposure prompted the authors to remove the expanders and perform bilateral transverse rectus abdominis myocutaneous flaps, where the right flap was de-epithelialized and placed in the same subpectoral pocket. Postoperatively, she developed pectoralis major muscle spasms in right breast, which were refractory to botulinum toxin treatment. Eventually, neurectomy of both medial and lateral pectoral nerves was performed with complete resolution of symptoms.

Although not identical, the above-mentioned cases share important similarities to our patient. In each case, the pectoralis major was elevated off the chest wall and stretched, either by insertion of an implant, expander or autologous flap beneath it, or by suturing it to the contralateral pectoralis muscle. The elevation, mobilization and distension of pectoralis major muscle and resulting tension on the medial and lateral pectoral nerves likely play a role in the pathophysiology of the muscle spasms described. However, despite performing a thorough review of the literature, no documentation supporting this hypothesis was found.

Nonetheless, as demonstrated by the novel application of the PECS1 block, local anesthesia of the medial and lateral pectoral nerves resulted in complete resolution of symptoms, supporting the hypothesis that the nerves are involved in the pathophysiology of this rare presentation. As previously mentioned, this technique utilizes ultrasound guidance to inject local anesthetic in the vicinity of both pectoral nerves. A colour Doppler function is used to identify the pectoral branch of thoracoacromial artery as it reliably courses along the lateral pectoral nerve (6).

To better understand the anatomy involved in the PECS1 block, clinical anatomy literature pertaining to the course and branches of the medial and lateral pectoral nerves was reviewed. In an anatomic study of eight unembalmed cadavers, Macchi et al (7) demonstrated the constant and parallel course of the lateral pectoral nerve to the pectoral artery and veins. Furthermore, they showed that the nerve coursed on the deep surface of pectoralis major for 55±7 mm and was visible under the muscle fascia. The medial pectoral nerve, however, demonstrated a variable course, which was broadly categorized into two patterns. In the first pattern, it pierced the pectoralis minor muscle as single trunk, then branched into several branches, some of which reach the deep surface of pectoralis major and innervate it. In the second pattern, the nerve gives off a lateral branch before entry into the pectoralis minor, which courses beneath the muscle and passes around its lower border to abut in the pectoralis major. The main trunk of the nerve pierces the pectoralis minor, then branches into several branches, some of which end in the pectoralis major. Interestingly, 14 of 16 limbs demonstrated communication between medial and lateral pectoral nerves, which underlines the importance of performing neurectomies on both nerves to achieve resolution of symptoms. Finally, the mean distance between the entry of medial and lateral pectoral nerves into pectoralis major was 30.7±10 mm. This supports the theory that injection of local anesthetic in vicinity of the lateral pectoral nerve will effectively anesthetize both medial and lateral pectoral nerves.

The current study demonstrated that, although excessively rare, severe spasms of the pectoralis major may occur with placement of implant or expander in the submuscular plane in breast reconstruction. Furthermore, a novel application of the PECS1 interfascial nerve block was shown to be an effective diagnostic modality, implicating the medial and lateral pectoral nerves in these muscle spasms. Additional research investigating the pathophysiology of muscle spasms and their relationship with nerve stretch is warranted.

REFERENCES